(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 298 585 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 88304091.7

(51) Int. Cl.4: **A61M 5/28 , A61M 5/315**

(22) Date of filing: **06.05.88**

(30) Priority: **08.07.87 US 72015**

(43) Date of publication of application:
11.01.89 Bulletin 89/02

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

Allow but not piston support

(71) Applicant: **DUOJECT MEDICAL SYSTEMS INC**
Suite 308 4920 de Maisonneuve Street
West Montreal Quebec H3Z 1N1(CA)

(72) Inventor: **Reynolds, David L.**
Suite 400 2000 West Broadway
Montreal Quebec, H4B 2A2(CA)

(74) Representative: **Newby, John Ross et al**
J.Y. & G.W. Johnson Furnival House 14/18
High Holborn
London WC1V 6DE(GB)

(54) Syringe.

(57) A prefilled syringe for one or two component medicaments is based upon the use of a vial (6) containing a medicament or one component (A) of a medicament, the vial having an open bottom closed by a piston (8). When the piston is coupled with a plunger (10), and an adapter cap (2) having an internal needle (22) and an external connection (27) for a needle is placed over a cap (4) of the vial (6), the latter is converted into a prefilled syringe. The piston has an axial passage (46, 48) closed by a resealable septum (50), so that a separate diluent (B) stored in a flexible capsule (14) may be introduced into the vial (6) through the piston (8) by a double ended needle (42, 44) mounted on a further cap (12) applied to the capsule (14), the further cap being coupled within the tubular interior of the plunger so that the double ended needle penetrates the septum (50) in the piston. The capsule (14) is pushed forward onto the double ended needle when its contents are to be expelled into the vial (6). The capsule (14) and its cap are then removed and discarded. Alternatively, the outer end of the needle on the further cap may be replaced by a coupling to the external connection on the adapter cap so that the capsule faces the syringe and the capsule may be pressed towards the syringe so that the needle within the further cap penetrates the capsule, the needle within the adapter cap penetrates the vial, and the contents of the capsule can be transferred to the vial before the capsule and its cap are discarded.

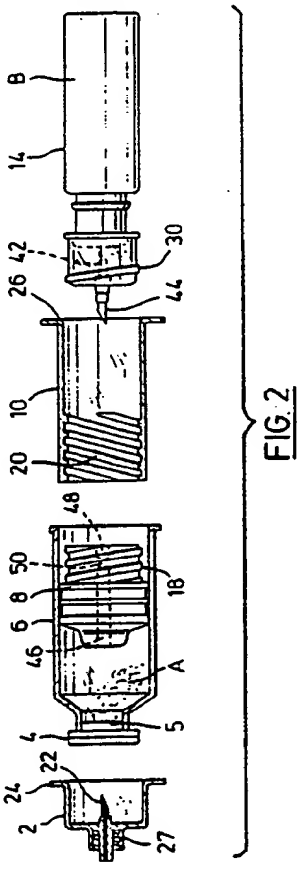


FIG. 2

EP 0 298 585 A1

SYRINGE

This invention relates to prefilled syringes for use in medical or veterinary treatment.

There has been an increasing trend in recent years to the putting up of pharmaceuticals in dosage forms so as to minimize the preparation required to administer a medicament to a patient and to reduce the chances of dosage errors or contamination. One dosage form which has been gaining rapid acceptance is the prefilled disposable syringe. Various difficulties are however associated with the preparation and usage of such syringes, particularly in the case of preparations which, in ready to use condition, have a short shelf life. Numerous forms of dual compartment syringe structure have been proposed for the shipping of such preparations with components stored in separate compartments for admixture immediately prior to use. Although certain structures have met with some degree of acceptance, they are commonly difficult to manufacture and/or use because of difficulties in filling the syringe with the components, and because they require extensive manipulation immediately prior to use. Moreover they are frequently substantially more bulky than conventional syringes because in many cases they frequently comprise components which effectively represent two syringes in tandem.

Problems in the manufacture of prefilled syringes are not confined to two component systems and even with single component systems the filling of syringes under factory conditions is difficult to mechanize effectively and requires expensive special purpose syringe filling machinery. The same applies to related units prefilled with liquids required for injection or infusion during medical procedures.

Another approach where single component systems are involved is exemplified by British Patent Specifications Nos. 1,252,306 and 1,444,119, and U. S. Patent No. 4,445,895, in which a prefilled cartridge having a displaceable plug at one end, and a needle penetrable closure at an opposite end, is inserted into the barrel of a syringe for dispensing of its contents. Whilst such cartridges and the equipment for filling them are known and available, they are only really suitable for preparations which can be stored in liquid form, and require either a special or a modified syringe for their use.

In a further arrangement disclosed in U. S. Patent No. 3,845,763, a cartridge or vial is closed at its bottom end by a slidable plug with a downwardly extending stem, which cartridge or vial is inserted bottom end first into a special holder which carries a double ended needle, so that the stem is penetrated by the needle and the body of the vial is converted into a plunger which can be depressed to expel the contents of the vial through the stem. The projecting stem means that the vial cannot be filled utilizing conventional vial filling machinery.

The present invention seeks to provide a system for the distribution of preparations required for injection or infusion in liquid dosage form during medical procedures, which has a wide range of utility both for single component liquid preparations or for two component systems of which one component may be a solid, which utilizes a small number of components all suitable for mass production, and which is simple to assemble and fill utilizing available equipment.

The invention is based upon the use of vials designed so that they may be filled utilizing conventional filling machinery and techniques, yet also form the barrel of a syringe in a prefilled syringe system which can be adapted for the dispensing of single or two component systems, including two component systems of the kind in which the solid component is lyophilized in situ during manufacture of the syringe.

In the context of the invention, it should be understood that "vial" refers to a particular type of container, having a rather squat cylindrical body whose height compared to the diameter of its base is such that it may stand stably on its base whilst being conveyed through a vial filling machine and subsequently sealed and capped. A vial has a neck with a large enough internal diameter to permit filling from a vial filling machine: solid filling materials will normally require a larger neck than liquids. Vials should not be confused with cartridges, which are comparatively long and slim, and cannot usually be filled utilizing vial filling machinery since they are too tall to rest stably on their bases.

Accordingly the present invention provides a vial containing injectable material, said vial comprising a cylindrical body, a flanged neck at the top of the body having an internal diameter sufficient to receive said injectable material from a vial filling machine, a needle penetrable closure applied to the neck and an annular cap applied to the flange and securing the closure to the neck, wherein the cylindrical body of the vial has an open bottom end with a rim of sufficient external diameter to provide a stable support for the vial when conveyed in an upright position through vial filling and closing machinery, a piston is sealingly received wholly within said body beneath said injectable material and above said bottom end, the piston including means to establish a positive coupling to a plunger in-

serted into said bottom end whereby the coupling of such a plunger and the application of an outer cap including a needle carrier to said cap converts said vial into a syringe.

The differences between such a vial and a conventional vial do not prevent it from being filled and capped in conventional vial filling and capping machinery; indeed, apart from the replacement of the bottom wall of the vial by a piston as specified, it is a conventional vial, and can be handled normally by the machinery during filling with either liquid or solid material. Furthermore, liquid filled vials may be lyophilized utilizing special stoppers either as known in the art or as described below.

Such a vial in accordance with the invention may be converted into a syringe by the addition of a plunger coupled to the piston and an outer cap which acts as a needle carrier. More specifically, the syringe includes as well as the vial a plunger connected to said piston, and an outer cap engaged over the cap of said vial, the outer cap having a hollow needle projecting axially within the cap and a coupling for engagement with injection means and communicating with said hollow needle, the outer cap being axially movable relative to said cap of the vial from a position in which the needle ends short of the cap of the vial to a position in which it penetrates the cap of the vial, and both the plunger and the outer cap being provided with radially extending flanges for sustaining actuating forces applied to the syringe.

In a syringe for a two component medicament, it is necessary to provide for packaging of the second component and its admixture with the first component in the vial prior to dispensing. The invention thus further extends to a capsule assembly comprising a generally cylindrical sealed capsule having walls formed of a flexible needle penetrable material, a generally cylindrical neck defined by said walls at one end of the capsule, said neck having axially spaced inner and outer peripheral ridges, and a generally cylindrical cap applied to said neck so that a detent within the cap engages the outer peripheral ridge on the neck, a double ended hollow needle passing through said cap so that an inner end within the cap ends short of the neck of the capsule and an outer end extends outwardly of the cap, the cap being displaceable relative to the capsule to a position in which the detent rides over the inner ridge and the inner end of the needle penetrates the neck of the capsule, the cap and capsule being of a diameter such that they can enter the tubular plunger to a position in which the outer end of the needle on the cap of the capsule penetrates the septum of the piston when the plunger is engaged with the latter.

Thus the injection system comprises a sequence of components of which various subsequences can be combined to form injection systems for preparations requiring shipping and storage as two separate components, certain subsequences themselves having utility respectively as injection systems for single component liquid preparations. "Injection" is utilized broadly to cover hypodermic, intramuscular and intravenous injection, gravity and mechanical infusion, and injection into other vessels utilized in medical treatment or testing. For the purposes of description, the "front" of an injection system will be considered the end of the system from which a liquid preparation is so injected.

The arrangement including the capsule assembly has a number of advantages in the manufacture and use of prefilled syringes for two component systems; furthermore, without the third cap and the sealed capsule containing the second component the remaining components provide, according to a further feature of the invention, advantages in the manufacture and use of prefilled syringes for single component systems. The third cap and sealed capsule provide, according to yet a further feature of the invention, an advantageous subsystem for various applications in which a sealed sterile source of a liquid is required for injection, or dropwise introduction into other containers used in medical procedures. With prefilled syringes for two components systems, either the capsule or the capsule and the third cap, may be sold, or shipped separately. This enables different diluents or sizes of capsule to be selected, or a common set of diluent capsules to be utilized with syringe assemblies containing different first components, thus simplifying inventory control.

Further features of the invention will become apparent from the following description of a preferred embodiment thereof with reference to the accompanying drawings.

In the drawings:

Figure 1 is a perspective exploded view of the mechanical components of a syringe system including a vial in accordance with the invention;

Figure 2 is a partially longitudinally sectioned, partially exploded view of the syringe components showing some further details of their construction;

Figures 3, 4 and 5 illustrate preparation of the syringe system to provide a syringe ready for use;

Figures 6, 7 and 8 illustrate exemplary applications of the syringe;

Figures 9 and 10 illustrate an optional feature of a vial in accordance with the invention; and

Figures 11 and 12 are respectively assembled and exploded views of an alternative configuration of the syringe system according to the invention.

Referring to Figures 1 and 2, a syringe system for the injection of a liquid preparation stored as two components comprises seven primary mechanical components, apart from the components of the preparation, which latter are shown in Figure 2 but not Figure 1. The components of the preparation typically comprise a first component A which may be in any physical state suitable for storage in vial, and a second liquid component B, typically but not necessarily sterile water. The liquid component B is stored in a sealed capsule 14 of flexible material, manufactured using conventional techniques from a material, usually synthetic plastic, which is compatible with the contents of the capsule. The first component is stored in a cylindrical vial 6, typically of glass, and capped by an annular cap 4 which retains a conventional needle penetrable sealing member accessible through a central opening in the cap. By a vial is meant a cylindrical vessel which can assume a stable upright position supported by its base, the overall height of the vessel preferably not exceeding 2.5 times the external diameter of the rim of its base so that it remains stable when passing through conventional vial filling and capping equipment utilized to fill and cap the vial. A neck at the upper end of the vial 6, which is capped by the cap 4, has a relatively internal diameter characteristic of such vessels, usually not less than about 7.5 mm for liquid or 10 mm for solids, so that filling either liquids or solids can be readily achieved. The cap 4 is formed by a soft aluminum sleeve, having a flange retaining a sealing member formed by a soft rubber disc or plug 5 over or in the front end opening, and tightly crimped onto a neck at the front end of the vial so as to seal the latter. A major difference from conventional vials is that the conventional bottom wall of the vial is replaced by an axially movable piston 8 wholly within the vial and in sealing contact with the vial walls. When received within the vial 6, this piston in no way interferes with the handling of the vial using conventional machinery, and in particular permits the vial to be stood on its base with its neck (which forms the front end of the vial when in use) upwards as it passes through the filling and capping equipment.

The filled vial 6 may be converted into a prefilled syringe by applying an outer cap 2 over the cap 4 and positively attaching a cylindrical plunger sleeve 10 to the piston 8. The piston 8, typically formed of rubber, is moulded with a rearward extension 16 with an external thread 18, whilst the interior of the front end of the plunger sleeve 10 is formed with a complementary internal thread 20 so that it may be screwed onto the piston 8. The outer cap 2 fits over the inner cap 4 so that a hollow needle 22 formed within the cap 2 does not reach the plug 5. On the front of the cap 2 and in communication with the hollow needle 2 is a coupling adapter 27, for example similar to those sold under the trade mark **LUER-LOK**, for connection of the syringe to a needle 28 or other instrumentality (see Figures 6-8). The rear ends of both cap 2 and the sleeve 10 are formed with radially extending flanges 24 and 26 respectively which form finger grips for operation of the syringe. Thus if a user grips the syringe by the flanges as shown in Figure 6 and presses them towards each other, the cap 2 is pulled rearwardly onto the cap 4 so that the needle 22 penetrates the plug 5 and the contents of the syringe can be expelled through the needle 22 and the needle 28. It will be noted that the rear end of the vial 6 is formed with only a relatively slight external flange 7 rather than the wide finger flange commonly found on the barrels of conventional syringes. In the present arrangement, the flange 24 provides the function of such a finger flange, enabling the flange 7 to be reduced to a size which will avoid such interference between the flanges of adjacent vials as would cause tipping when the vials are conveyed in a vertical attitude through filling and capping equipment.

In many applications, it is desirable to prevent premature penetration of the plug 5 by the needle 22, and therefore the cap 2 may be moulded with short internal threads (not shown) which prevent rearward movement of the cap 2 unless it si twisted so that the threads bite into the soft aluminum of the cap 4 and draw the cap 2 rearwardly so that the needle 22 can penetrate the plug. A prefilled syringe so constructed has significant advantages over conventional prefilled syringes in that the vial may be filled using conventional vial filling equipment, and yet may be utilized directly instead of requiring its contents to be transferred to a syringe prior to use as has been conventional in the use of vials.

The vial may also be charged with material which is not directly injectable, such as solids which must be dissolved or suspended in a liquid medium prior to injection. In this case the liquid medium is sealed as already described in a flexible capsule 14. A third cap 12 is either applied to the capsule as shown in Figure 2, or inserted into the plunger sleeve 10 so that a screw thread 30 on the exterior of the cap engages the screw thread 20 within the sleeve.

A neck 34 of the capsule 14 has two peripheral ridges 36 and 28. If the cap 12 is applied to the capsule, a detent 40 within the cap is pushed over only the outer ridge 38 so that a rear end portion 42 of a hollow needle mounted in the cap stops short of the end of the capsule. By forcing the detent 40 rearwardly over the ridge 36, the needle portion 42 can be forced rearwardly so as to penetrate the capsule. A forward end portion 44 of the

hollow needle has a length such that when the cap 12 is screwed into the sleeve 10, and the sleeve 10 is screwed onto the piston 8, the needle portion 44 penetrates a resilient septum 50 normally separating axial passages 46 and 48 formed in the front and rear of the piston.

In use, if the capsule 14 and cap 12 are shipped as a separate unit, this unit is screwed into the sleeve 10 (see Figure 3), and the sleeve 10 is pushed into the rear of the vial 6 so that the needle portion 44 penetrates the septum 50 of the piston 8 and the thread 20 is screwed onto the thread 18 of the piston (see Figure 4). This action also substantially unscrews the cap 12 from the thread 20. The capsule 14 is then pressed forward onto the needle portion 42, and the liquid contents of the capsule can then be squeezed through the needle and into admixture with the first component in front of the piston 8. Thereafter the capsule 14 and cap 12 may be pulled as a unit from the sleeve 10 and discarded (see Figure 5). The septum 50 reseals as the needle portion 44 is withdrawn, leaving a syringe ready for use as illustrated in Figures 6 - 8. Alternatively, if the cap 12 is prefitted to the sleeve, the sleeve 10 may be screwed onto the piston 8, and the capsule 14 pressed into the sleeve 10 and the cap 12 so as to establish communication between the capsule and the space forward of the piston, the procedure thereafter being the same.

Rather than being used conventionally with a needle as shown in Figure 6, the prepared syringe may be used for gravitational or mechanical infusion as shown in Figures 7 and 8. In Figure 7, the adapter 27 is fitted to a complementary coupling on a gravity infuser 52 to provide a drip feed, the sleeve 10 having been unscrewed and discarded, together with the cap 12 and capsule 14, if used. In Figure 8, the syringe is mounted in a mechanical infuser 54 such as that sold under the trade mark **BARD**, the latter being equipped with clamps 56, 58, 60 suited for engagement with the syringe.

By basing the system on an open-bottomed vial 6 closed at its bottom end by a piston 8 equipped with means such as the screw thread 18 for coupling it to a plunger of sleeve form, and with a needle penetrable septum 50, in optional conjunction with sealed flexible capsules of diluent, great flexibility in application can be obtained, using components which are easy to fill, compact to ship, and easy to make ready for use.

Referring now to Figures 9 and 10, the rubber disk or plug retained by the cap 4 on the vial 6 may be replaced by a modified plug 60 as shown in perspective from beneath and one side in Figure 8, and partially installed on a vial 6 in Figure 9. Use of such a plug 60 is advantageous when the solid component of a medicament is to be prepared in situ in the vial by lyophilization. The vial is filled with a liquid preparation to be lyophilized, and plug 60 inserted to the position shown in Figure 9, so that the interior of the vial communicates with its environment through a central passageway 61 and radial bores 62, the passageway and the bores being no larger than needed for the removal of water vapour during lyophilization. The plug is split at 63 to facilitate moulding. After filling the contents of the vial are rapidly frozen and vacuum dried to leave a solid residue in the vial which can be reconstituted immediately before use. The plug 60 is then moved to the full extent permitted by a flange 64 into the neck of the vial 6 and secured by a cap 4. Whilst a conventional lyophilization stopper could be utilized in place of the plug 60, the latter has the advantage of minimizing the amount of liquid trapped within the stopper during use of the syringe. For the same reason, the head of the piston 8 is shaped so as to minimize dead space in the neck of the vial when the contents of the vial are expelled during use of the syringe.

Figures 11 and 12 illustrate an alternate configuration of the syringe. The various components are essentially identical to those already described, and the same reference numerals are utilized except that the outer needle (44) of the conduit extending through the cap (12) is replaced by an extension (70) which is configured at its outer end to couple with a standard syringe coupling such as the coupling (27) on the cap (2). This enables the capsule (14), once inserted in the plunger (10), to be locked through the extension (70) and the coupling (27) to the cap (2) to produce the compact assembly shown in Figure 11. To prepare the syringe for use, the cap (2) is forced rearwardly over the cap (4) so that the needle (22) (see Figure 2) pierces the seal (5), and the capsule (14) is forced forward so that it is pierced by the needle (42) and its contents can be expelled through the needle (42), the extension (70), the coupling (27) and the needle (22) into the vial (6). The assembly of the capsule (14) and the plunger (10) can then be released from the remainder of the syringe by turning so as to release the extension (70) from the coupling (27), a needle (not shown) may be applied to the coupling (27), the capsule (14) is removed from the plunger (11) and discarded, and the plunger (11) is screwed onto the coupling (18) to ready the syringe for use. With this arrangement, the passages (46 and 48) in the piston (8) are not required.

Claims

1. A vial containing injectable material, characterized in that said vial comprises a cylindrical body, a flanged neck at the top of the body having

an internal diameter sufficient to receive said injectable material from a vial filling machine, a needle penetrable closure applied to the neck and an annular cap applied to the flange and securing the closure to the neck, characterized in that the cylindrical body of the vial (6) has an open bottom end with a rim of sufficient external diameter to provide a stable support for the vial when conveyed in an upright position through vial filling and closing machinery, and a piston (8) is sealingly received wholly within said body beneath said injectable material (A) and above said bottom end, the piston including means (16) to establish a positive coupling to a plunger inserted into said bottom end whereby said vial may be converted into a syringe.

2. A vial according to Claim 1, characterized in that the means included by said piston (8) to establish a positive coupling with the plunger is a screw threaded extension (16) towards the open bottom end of the vial (6).

3. A vial according to Claim 1 or 2, characterized in that the piston (8) is moulded from resilient material and defines axial passages extending to opposite sides of the piston, with a penetrable resilient septum between the passages.

4. A vial according to Claim 1, 2 or 3, characterized in that the ratio of the overall height of the vial (6) to the external diameter of its base does not exceed 2.5:1.

5. A vial according to any of the preceding claims, characterized in that the neck of the vial (6) has an internal diameter of at least 7.5 mm.

6. A vial according to any of the preceding claims, characterized in that the needle penetrable closure (60) for the neck has a flange engaging the top of the neck, and a bung portion entering the neck, the bung defining a passageway (61) within the bung communicating with the interior of the vial, and further passageway means 62 between the passageway and the outer surface of the bung just beneath the flange, to provide means for venting the vial during lyophilization of the contents prior to application of the cap (4).

7. A syringe including a vial according to any of Claims 1 to 6, characterized in that it includes a plunger (10) connected to said piston (8), and an outer cap (2) engaged over the cap (4) of said vial (6), the outer cap (2) having a hollow needle (22) projecting axially within the cap and a coupling (27) for engagement with injection means and communicating with said hollow needle (22), the outer cap (2) being axially movable relative to said cap (4) of the vial (6) from a position in which the needle (22) ends short of the cap (4) of the vial to a position in which it penetrates the cap (4) of the vial, and both the plunger (10) and the outer cap (2) being provided with radially extending flanges (26, 24) for sustaining actuating forces applied to the syringe.

8. A syringe including a vial according to Claim 3, characterized in that it includes a tubular open ended plunger (10) connected to said piston (8), and an outer cap (2) engaged over the cap (4) of said vial (6), the outer cap (2) having a hollow needle (22) projecting axially within the cap (2) and a coupling (27) for engagement with injection means and communicating with said hollow needle (22), the outer cap (2) being axially movable relative to said cap (4) of the vial (6) from a position in which the needle (22) ends short of the cap of the vial to a position in which it penetrates the cap 4 of the vial, and both the plunger (10) and the outer cap (2) being provided with radially extending flanges (26, 24) for sustaining actuating forces applied to the syringe.

9. A syringe according to Claim 8, characterized in that it includes a capsule assembly comprising a generally cylindrical sealed capsule (14) having walls formed of a flexible needle penetrable material, a generally cylindrical neck (34) defined by said walls at one end of the capsule, said neck having axially spaced inner and outer peripheral ridges (36, 38), and a generally cylindrical cap (12) applied to said neck so that a detent (40) within the cap engages the outer peripheral ridge (38) on the neck, a double ended hollow conduit (42, 44 or 70) passing through said cap (12) so that a needle (42) forming an inner end within the cap ends short of the neck (34) of the capsule and an outer end (44 or 70) extends outwardly of the cap, the cap (12) being displaceable relative to the capsule (14) to a position in which the detent (40) rides over the inner ridge (36) and the inner end (42) of the needle penetrates the neck (34) of the capsule, the cap (12) and capsule (14) being of a diameter such that they can enter the tubular plunger (10).

10. A syringe according to Claim 9, characterized in that the outer end of the conduit is a needle (44), and the cap (12) and capsule (14) can enter the plunger (10) to a position in which the needle (44) penetrates the septum (50) of the piston (8) when the plunger is engaged with the latter.

11. A syringe according to Claim 9, characterized in that the outer end of the conduit is configured to engage the coupling (27) on the outer cap (2), whereby both the plunger (10) and the capsule (12) inserted therein may be locked to the outer cap (2) for transit, and the capsule (14) may be forced into the capsule (12) and the outer cap (2) forced onto the inner cap (4) so as to place the capsule (14) in communication with the vial (6) through the conduit (42,70), the coupling (27) and the needle (22) within the outer cap (2).

12. A syringe according to Claim 9, 10 or 11, characterized in that the cap (12) of the capsule has an external screw thread (30), and the tubular plunger has an internal screw thread (20) engageable with said external thread.

13. A syringe according to any of Claims 9-12, characterized in that the means on the piston (8) for coupling to the plunger is an external screw thread (18) engageable with the internal screw thread (20) of the tubular plunger.

14. A prefilled syringe system for dispensing a two component medicament characterized in that it comprises in combination:

a) an outer cap (2) having a forwardly facing attachment (27) for engagement with a hollow needle or other dispensing instrumentality and a rearwardly facing hollow piercing needle (22) within and of a depth less than the cap;

b) an inner cap (4) which is capped by the outer cap (2), the latter including means (24) by which it may be forced rearwardly relative to the inner cap (4), the inner cap retaining a seal (5) for penetration by the inwardly facing piercing needle (22) of the outer cap (2) when the latter is forced rearwardly;

c) a generally cylindrical vial (6) closed at its front end by said seal (5) and open at its rear end;

d) a piston (8) axially movable within the vial (6) and maintaining a first component (A) of said medicament sealed within said vial (6) between the seal (5) and the piston (8);

e) a hollow cylindrical plunger (10), the piston and plunger having coupling means (18, 20) enabling the plunger to be engaged with the piston and to be manipulated from a relatively rearward position relative to the piston to a relatively forward position relative to the piston;

f) a third cap (12) received within and releasably engageable with the interior of the plunger (10), the third cap having a double ended hollow conduit through it, that portion of the conduit within the third cap being a needle (42), and that portion of the conduit external of the cap being adapted to establish fluid communication with the interior of the vial (6); and

g) a sealed collapsible capsule (14) containing a second, liquid component (B) of the preparation, the capsule having one end portion (34) entering one end of the plunger (10) and engaging the interior of the third cap (12), and a deformable other end portion extending outwardly of the plunger (10) whereby the other end portion may be manipulated to drive the forward portion (34) of the capsule onto the needle (42) and permit the component (B) to be discharged through the hollow conduit.

15. A syringe system according to Claim 14, wherein that portion of the conduit external of the third cap is a needle (44), the external projection of the needle being such that when the cap (12) is engaged with the plunger, and the plunger (10) is in its rearward position relative to the piston (8), the needle does not penetrate the piston (8), and when the plunger (10) is in its forward position relative to the piston (8) the needle does penetrate the piston.

16. A syringe system according to Claim 14, wherein that portion (70) of the conduit external of the third cap has a coupling for engagement with the forwardly facing attachment (27) of the outer cap (2), whereby to secure the capsule (14) and the plunger (10) to the outer cap (2) so that by forcing the one end of the capsule (14) into the third cap (12), and the outer cap (2) onto the inner cap (4), the interior of the capsule (14) is placed in communication with the interior of the vial (6) through the needle (42), the conduit portion (70), the attachment (27) and the needle.

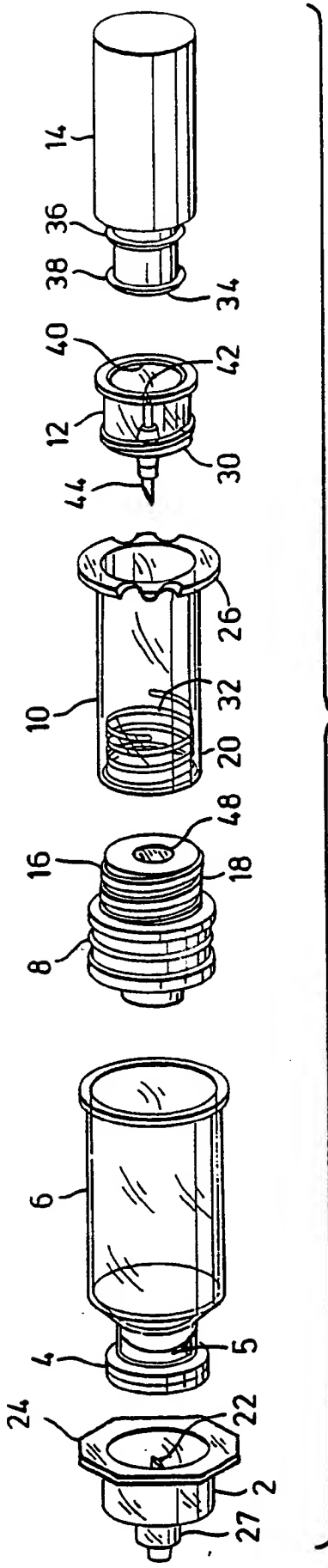

14
36
38
34
40
42
12
30
44
26
32
10
20
48
16
18
8
6
4
5
24
22
2
27

FIG. 1

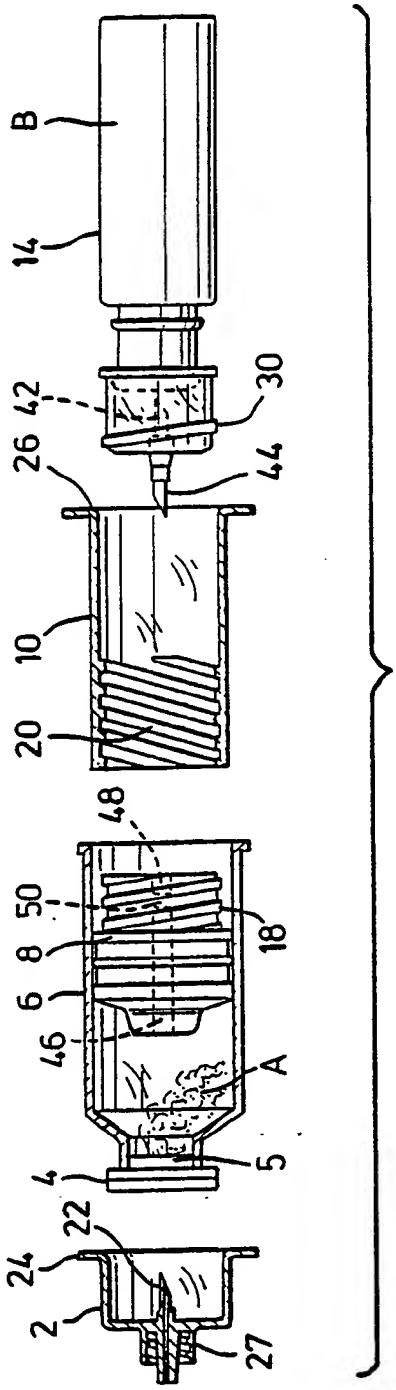

B
14
42
30
26
44
10
20
48
50
18
8
6
46
A
4
5
22
24
2
27

FIG. 2

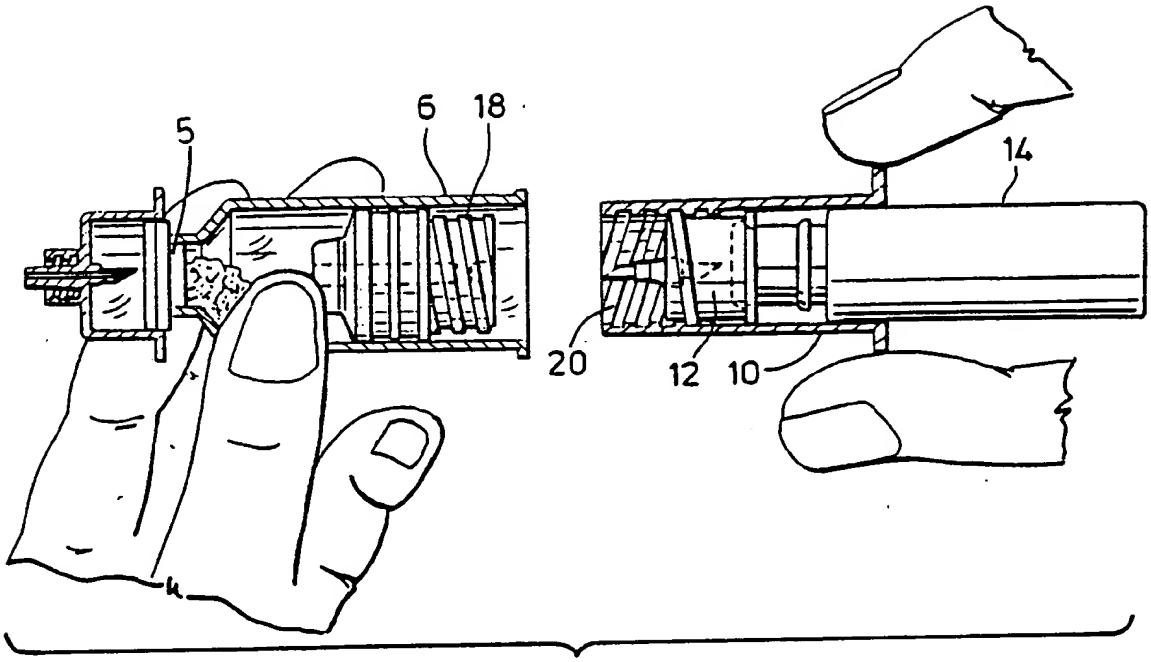


FIG. 3

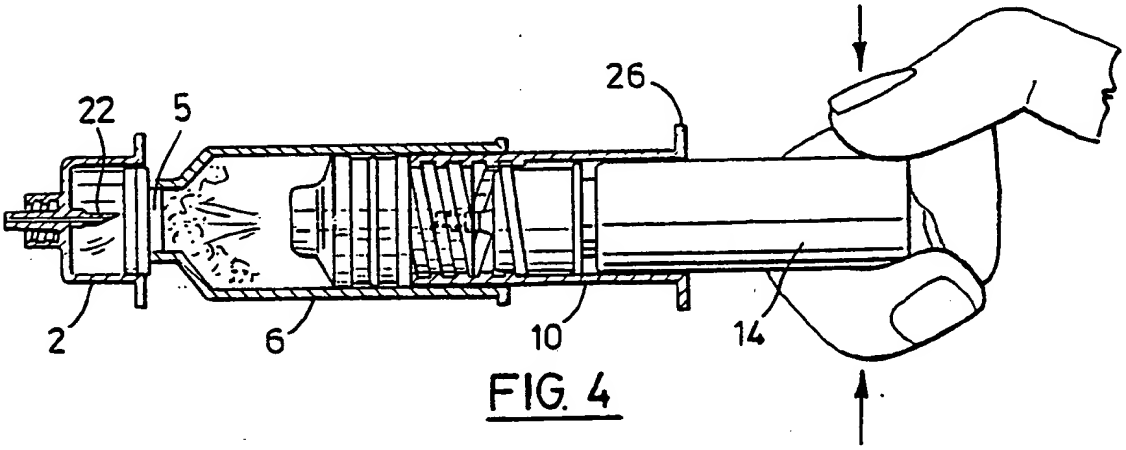


FIG. 4

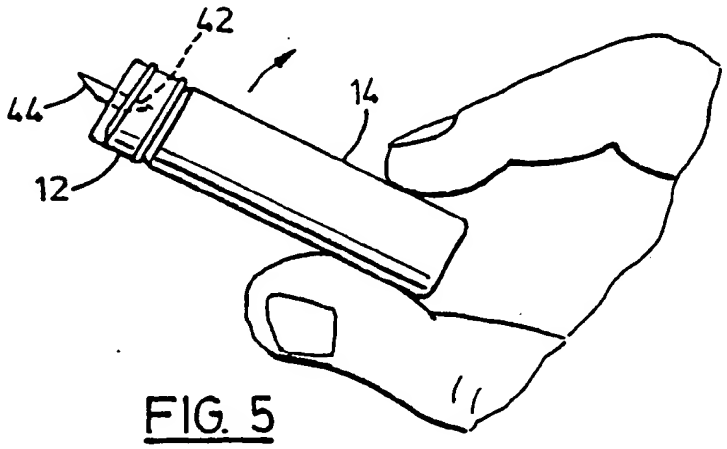


FIG. 5

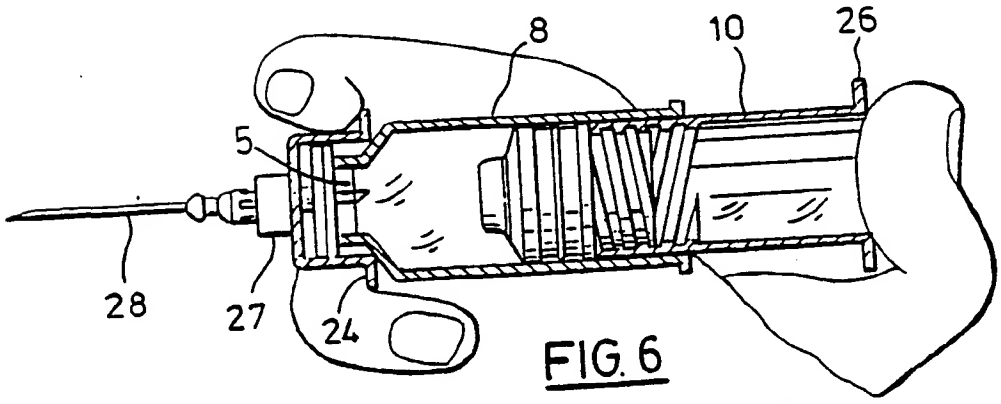


FIG. 6

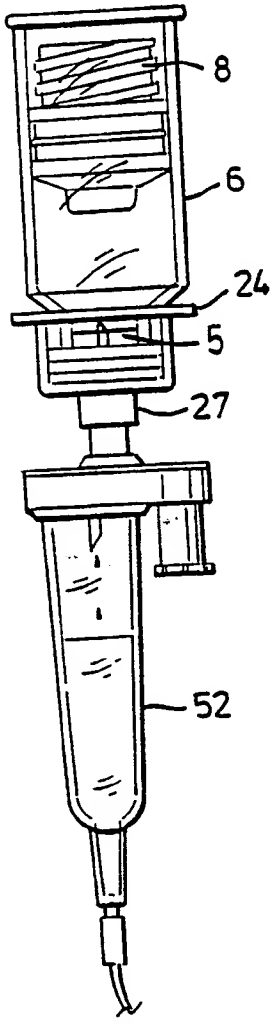


FIG. 7

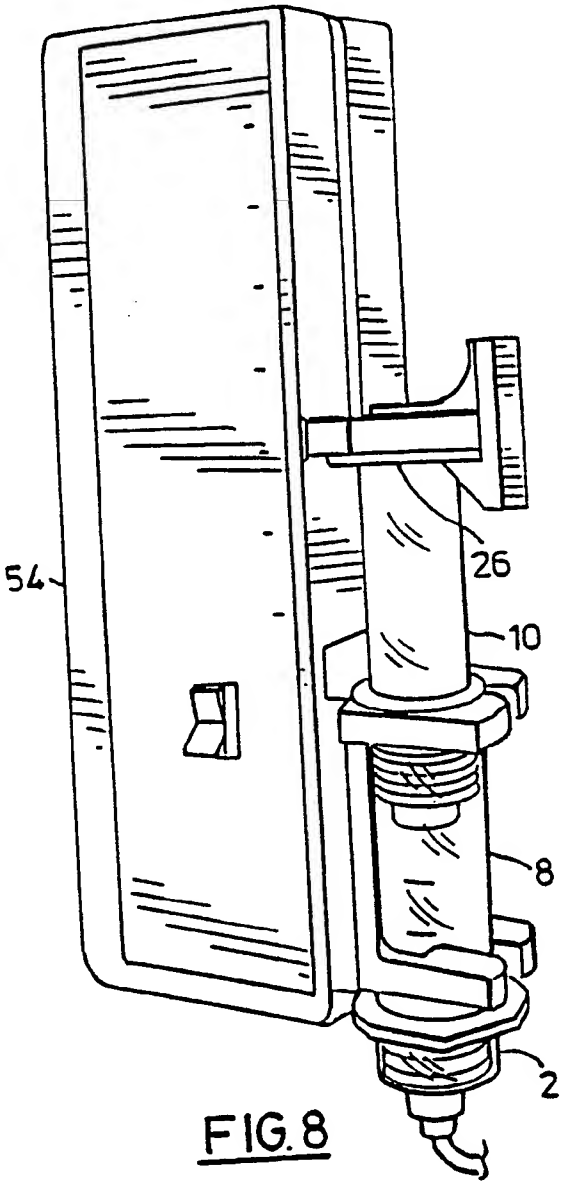
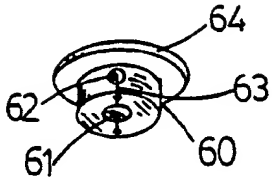


FIG. 8

FIG. 9



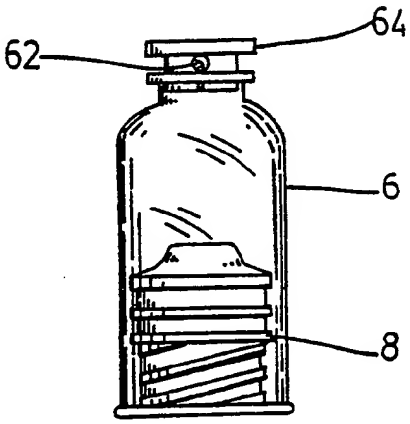


FIG. 10

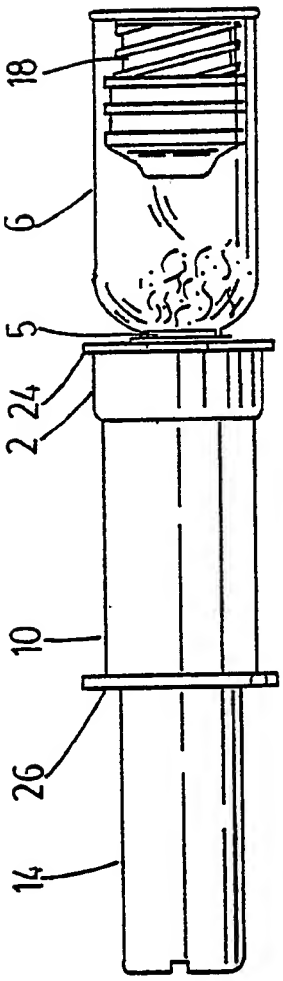


FIG.11

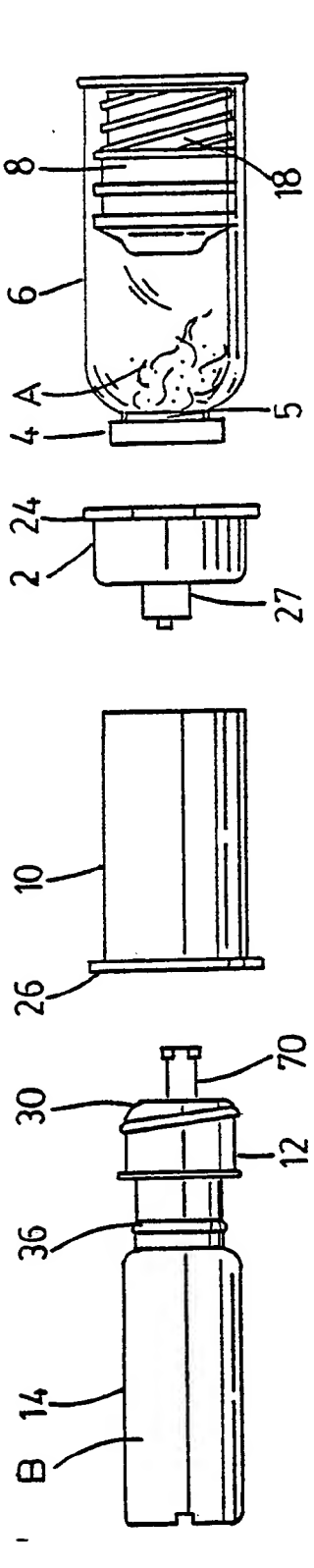


FIG.12

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 30 4091

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-4 424 057 (H.A.HOUSE) * Figures 1,2; column 4, lines 49-55; column 5, lines 1-15; claim 1 *	1,2,3,7	A 61 M 5/28 A 61 M 5/315
A	---	14	
X	DE-A-1 766 151 (BAYER AG) * Page 5, first paragraph *	1,2	
A	---	1	
	US-A-4 581 023 (D.H.KUNTZ) * Figures 1-3; column 4, lines 50-60 *		
A,D	---	1	
	US-A-4 445 895 (M.MARGULIES) * Figures 1A-1C *		
A	---	1	
	US-A-3 785 379 (M.J.COHEN) * Figure 1 *		
A	---	1	
	US-A-3 437 090 (S.J.SARNOFF) * Column 1, line 60 - column 2, line 42 *		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A 61 M 5/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12-10-1988	

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)